NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND

(No.)
CODE 378

DEFINITION

A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at spillway elevation is 3 ft or more.

PURPOSE

To provide water for livestock, fish and wildlife, recreation, fire control, crop and orchard spraying, and other related uses, and to maintain or improve water quality.

SCOPE

This standard establishes the minimum acceptable quality for the design and construction of ponds if:

1. Failure of the dam will not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.
2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the emergency spillway. The effective height of the dam is the difference in elevation, in feet, between the emergency spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no emergency spillway, the top of the dam is the upper limit.
3. The effective height of the dam is 35 ft or less, and the dam is hazard class (a).

CONDITIONS WHERE PRACTICE APPLIES

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed emergency spillway, (2) a combination of a principal spillway and an emergency spillway, or (3) a principal spillway.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater flow will maintain an adequate supply of water in the pond. The quality shall be suitable for the water's intended use.

Reservoir area. The topography and soils of the site shall permit storage of water at a depth and volume that ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

DESIGN CRITERIA FOR EMBANKMENT PONDS

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall not be steeper than one horizontal to one vertical.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage creates swamping downstream, (3) such control is needed to insure a stable embankment, or (4) special problems require drainage for a stable dam. Seepage may be controlled by (1) foundation, abutment, or embankment drains; (2) reservoir blanketing; or (3) a combination of these measures.

Earth embankment. The minimum top width for a dam is shown in table 1. If the embankment top is to be used as a public road, the minimum width shall be 16 ft for one-way traffic and 26 ft for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

Table 1.- Minimum top width for dams

Total height of embankment	Top width
ft	*ft*
10 or less	6
10 - 15	8
15 - 20	10
20 - 25	12
25 - 35	14
35 or more	15

The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required.

If needed to protect the slopes of the dam, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (Technical Releases 56 and 69).

The minimum elevation of the top of the settled embankment shall be 1 ft above the water surface in the reservoir with the emergency spillway flowing at design depth. The minimum difference in elevation between the crest of the emergency spillway and the settled top of the dam shall be 2 ft for all dams having more than a 20-acre drainage area or more than 20 ft in effective height.

The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent, except where detailed soil testing and laboratory analyses show that a lesser amount is adequate.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of mechanical spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

The crest elevation shall be no less than 0.5 ft below the crest of the emergency spillway for dams having a drainage area of 20 acres or less, and no less than 1 ft for those having a drainage area of more than 20 acres.

When design discharge of the principal spillway is considered in calculating peak outflow through the emergency spillway, the crest elevation of the inlet shall be such that the full flow will be generated in the conduit before there is discharge through the emergency spillway. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the emergency spillways. The diameter of the pipe shall not be less than 4 in.

If the pipe conduit diameter is 10 in or greater, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway.

Pipe conduits under or through the dam shall meet the following requirements. The pipe shall be capable of withstanding external loading without yielding, buckling, or cracking. Flexible pipe strength shall not be less than that necessary to support the design load with a maximum of 5 percent deflection. The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe. All pipe joints shall be made watertight by the use of couplings, gaskets, caulking, or by welding.

For dams 20 ft or less in effective height, acceptable pipe materials are cast-iron, steel, corrugated steel or aluminum, asbestos-cement, concrete, plastic, vitrified clay with rubber gaskets, and cast-in-place reinforced concrete. Asbestos-cement, concrete, and vitrified clay pipe shall be laid in a concrete bedding. Plastic pipe that will be exposed to direct sunlight shall be made of ultraviolet-resistant materials and protected by coating or shielding, or provisions for replacement should be made as necessary. Connections of plastic pipe to less flexible pipe or structures must be designed to avoid stress concentrations that could rupture the plastic.

For dams more than 20 ft in effective height, conduits shall be plastic, reinforced concrete, cast-in-place reinforced concrete, corrugated steel or aluminum, or welded steel pipe. The maximum height of fill over any principal spillway steel or aluminum pipe must not exceed 25 ft. Pipe shall be watertight. The joints between sections of pipe shall be designed to remain watertight after joint elongation caused by foundation consolidation. Concrete pipe shall have concrete bedding or a concrete cradle, if required. Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Other suitable devices such as a Saint Anthony Falls stilling basin or an impact basin may be used to provide a safe outlet. Protective coatings of asbestos-bonded, asphalt coated, or vinyl coating on galvanized corrugated metal pipe, or coal tar enamel on welded steel pipe should be provided in areas that have a history of pipe corrosion, or where the saturated soil resistivity is less than 4,000 ohms-cm, or where soil pH is lower than 5.

Specifications in tables 2 and 3 are to be followed for polyvinyl chloride (PVC), steel, and aluminum pipe.

Cathodic protection is to be provided for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating, and where the need and importance of the structure warrant additional protection and longevity. If cathodic protection is not provided for in the original design and installation, electrical continuity in the form of joint-bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need.

Practice standard 430-FF provides criteria for cathodic protection of welded steel pipe.

Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 ft.
2. The conduit is of smooth pipe larger than 8 in. in diameter.
3. The conduit is of corrugated pipe larger than 12 in. in diameter.

Table 2.- Acceptable PVC pipe for use in earth dams[1]

Nominal pipe size	Schedule for standard dimension ratio (SDR)	Maximum depth of fill over pipe
in		*ft*
4 or less	Schedule 40	15
	Schedule 80	20
	SDR 26	10
6,8,10,12	Schedule 40	10
	Schedule 80	15
	SDR 26	10

[1]Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ATSM-D-1785 or ATSM-D-2241.

Table 3.- Minimum gage for corrugated metal pipe [2-2/3-in x ½-in corrugations][1]

Fill height (ft)	Minimum gauge for steel pipe with diameter (in) of ——					
	21 and less	24	30	36	42	48
1 - 15	16	16	16	14	12	10
15 - 20	16	16	16	14	12	10
20 - 25	16	16	14	12	10	10

Fill height (ft)	Minimum thickness (in) of aluminum pipe[2] with diameter (in) of ——			
	21 and less	24	30	36
1 - 15	0.06	0.06	0.075	0.075
15 - 20	0.06	0.075	0.105	0.105
20 - 25	0.06	0.105	0.105	----[3]

1 Pipe with 6-, 8-, and 10-in diameters has 1-1/2 in x ¼-in corrugations.

2 Riveted or helical fabrication.

3 Not permitted.

Seepage along pipes extending through the embankment shall be controlled by use of a filter and drainage diaphragm, unless it is determined that antiseep collars will adequately serve the purpose

The drain is to consist of sand, meeting fine concrete aggregate requirements (at least 15% passing the No. 40 sieve but no more than 10% passing the No. 100 sieve). If unusual soil conditions exist, a special design analysis shall be made.

The drain shall be a minimum of 2 ft thick and extend vertically upward and horizontally at least three times the pipe diameter, and vertically downward at least 18 in. beneath the conduit invert. The drain diaphragm shall be located immediately downstream of the cutoff trench, approximately parallel to the centerline of the dam.

The drain shall be outletted at the embankment downstream toe, preferably using a drain backfill envelope continuously along the pipe to where it exits the embankment. Protecting drain fill from surface erosion will be necessary.

When antiseep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe. Collar material shall be compatible with pipe materials. The antiseep collar(s) shall increase by 15% the seepage path along the pipe.

Closed conduit spillways designed for pressure flow must have adequate antivortex devices.

To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser.

A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by State law. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Supply pipes through the dam to watering troughs and other appurtenances shall have an inside diameter of not less than 1-1/4 in.

Emergency spillways. Emergency spillways convey large flood flows safely past earth embankments.

An emergency spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an emergency spillway: a conduit with a cross-sectional area of 3 ft^2 or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in table 4, less any reduction creditable to conduit discharge and detention storage.

The emergency spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days' drawdown, whichever is higher. The 10-day drawdown shall be computed from the crest of the emergency spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Emergency spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed emergency spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth. The side slopes shall be stable for the material in which the spillway is to be constructed. For dams having an effective height exceeding 20 ft, the emergency spillway shall have a bottom width of not less than 10 ft.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed emergency spillway shall fall within the range established by discharge requirements and permissible velocities.

Structural emergency spillways. If chutes or drops are used for principal spillways or principal emergency or emergency spillways, they shall be designed according to the principles set forth in the Engineering Field Manual for Conservation Practices and the National Engineering Handbook-Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in table 4, less any reduction creditable to conduit discharge and detention storage.

Visual resource design. The visual design of ponds shall be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

DESIGN CRITERIA FOR EXCAVATED PONDS

Runoff. Provisions shall be made for a pipe and emergency spillway if necessary. Runoff flow patterns shall be considered when locating the pit and placing the spoil (see table 4).

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical. If livestock will water directly from the pond, a watering ramp of ample width shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than three horizontal to one vertical.

Perimeter form. If the structures are to be used for recreation or are highly visible to the public, the perimeter or edge should be curvilinear.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and so that it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 ft, with the top graded to a continuous slope away from the pond.
2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 ft from the edge of the pond.
3· Shaped to a designed form that blends visually with the landscape.
4· Used for low embankment and leveling.
5· Hauled away.

Table 4.-Minimum spillway capacity

			Minimum design storm[2]	
Drainage area	Effective ht. of dam[1]	Storage	Frequency	Minimum duration
acre	*ft*	*ac-ft*	*yr*	*hr*
20 or less	20 or less	< than 50	10	24
20 or less	> than 20	< than 50	25	24
> than 20		< than 50	25	24
All others			50	24

1. As defined under "Scope."
2. Select rain distribution based on climatological region.

PLANNING CONSIDERATIONS

Water Quantity

1. Effects upon components of the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

2. Variability of effects caused by seasonal or climatic changes.

3. Effects on the downstream flows or aquifers that could affect other water uses or users.

4. Potential for multiple use.

5. Effects on the volume of downstream flow to prohibit undesirable environmental, social or economic effects.

Water Quality

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment attached substances that are carried by runoff.

2. Effects on the visual quality of onsite and downstream water resources.

3. Short-term and construction-related effects of this practice on the quality of downstream water courses.

4. Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.

5. Effects on wetlands and water-related wildlife habitats.

6. Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.

7. Effects of soil water level control on the salinity of soils, soil water, or downstream water.

8. Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

PLANS AND SPECIFICATIONS

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

NATURAL RESOURCES CONSERVATION SERVICE

PRACTICE STANDARD

(Texas Addendum)

POND

(No.)

Code 378

This addendum serves as an integral part to the companion Standard of the National Handbook of Conservation Practices. The contents of this addendum magnify national guidance and implement experience factors important to the installation of this practice under the range of conditions found within Texas. Criteria or guidance contained herein addresses items to be conformed to in addition to satisfying the items of the Standard in the National Handbook of Conservation Practices.

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Conditions Where Practice Applies

<u>Drainage Area</u>. Large drainage areas may be used as the source of water for Excavated Ponds provided the ponds can be located on sites where the flow is diverted away from the structure after the pit fills with water.

Seep type ponds may be used in areas where a subsurface water table will provide adequate supply for intended purpose.

Reservoirs completely enclosed with an embankment may be used if adequate water supply can be pumped or otherwise diverted into the pond.

<u>Reservoir Area</u>. Soils investigations shall be made to reasonably assure adequate materials are available for construction of a safe pond that will serve its intended purpose.

For a permanent water supply, it is necessary to provide sufficient water depth to meet the intended use and to offset seepage and evaporation losses. Minimum depth of embankment and excavated ponds shall be based on drawing number 4-L-29476 or Table 11-13 in the Engineering Field Manual for Conservation Practices.

During construction there may be a need to vary the minimum acceptable depth. Where physical conditions {such as bed rock or open gravel strata) preclude the completion of the pond to the desirable minimum depth, then the acceptable minimum depth will be determined by the zone engineer.

DESIGN CRITERIA FOR EMBANKMENT PONDS

<u>Earth Embankment</u>. The upstream slope of the settled embankment shall not be steeper than 3 to 1. Where the maximum height of the embankment exceeds 20 feet, the back slope shall not be steeper than 2.5 to 1. Allowance for shrinkage and settling shall be made at the rate of 5 percent, except that this shall be increased to 10 percent for dams constructed with bulldozers and 20 percent with draglines. Where a combination of equipment is used, the type of equipment having higher percentage factor shall govern. Dragline construction is limited to 10 feet of total embankment height.

<u>Principal Spillway</u>. Used welded steel pipe may be installed provided it is approved by an authorized NRCS representative as being essentially equal in quality to new pipe and wall thickness is equal to or greater than the wall thickness in the following table:

Nominal Pipe Diameter (inches}*	*Minimum Wall Thickness* (inches}*	*Weight Class**	*Nominal Weight per ft, Plain End, lb**
4	0.237	STD	10.79
5	0.258	STD	14.62
6	0.280	STD	18.97
8	0.322	STD	28.55
. 10	0.365	STD	40.48
12	0.375	STD	49.56
14	0.375	STD	54.57
16	0.375	STD	62.58
18	0.375	STD	70.59
20	0.375	STD	78.60
24	0.375	STD	94.62
26	0.375	STD	102.63

- *Reference: Table X2, ASTM A-53*

A stability analysis of the downstream channel shall be made. If the outlet channel is unstable, grade control structures, or pipe supports, or other acceptable measures shall be designed and installed to assure proper function of the principal spillway. Pipe supports shall extend below anticipated channel degradation and plunge basin scour hole. The outlet end of the pipe conduit shall extend sufficiently to assure that formation of the scour hole will not affect the downstream slope stability of the embankment.

If a pipe support is not installed, as a minimum, the outlet end of the pipe shall extend the lesser of 2.5 times the conduit diameter or 8 ft beyond the downstream toe at the channel bed.

The end section of pipe shall extend into the embankment a minimum of one conduit diameter if a pipe support is installed and a minimum of three conduit diameters without a pipe support. The extension length shall be measured from the intersection of the pipe crown and embankment slope to the upstream end of the pipe section. The minimum depth of cover over a band coupler shall be 2 feet.

Cathodic Protection shall be designed and installed in accordance with Design Note 12, Control of Underground Corrosion. Corrugated steel pipe with protective coatings such as asphalt, polymer, or asbestos bonded may be used without cathodic protection, if similar installations have performed satisfactorily for normal life expectancy. Noncoated galvanized or aluminized corrugated steel pipe may be installed in nonpermanently saturated soils if similar installations have performed satisfactorily for normal life expectancy.

Polymer coating or other acceptable coatings shall be installed where needed to prevent corrosion to the inside of the steel conduit.

National Engineering Manual (NEM) Part 543- MATERIALS 543.01 provides guidance on use of corrugated aluminum pipe.

If a principal spillway is installed to reduce peak discharges in the emergency spillway, it shall be designed to prevent orifice flow. Vertical inlets shall be designed structurally to withstand external pressure from soils and hydrostatic loading. A concrete base shall be used to prevent floatation of vertical inlets. Table 1, Gages for Vertical Inlets and Table 2, Concrete Footing Dimensions may be used in lieu of detailed designs for inlet strength and floatation requirements.

Design of hooded inlets shall be in accordance with Technical Release No.3 Hood Inlets for Culvert Spillways, except the minimum head required to produce pressure flow shall be 1.8 D measured from the invert of hood inlet. The anti vortex shall meet the requirements of SCS standard drawings. A cavitation check is not required if the total available head is less than 25 ft.

A debris or safety guard shall be installed on vertical inlets. The guard shall be installed according to SCS standard drawings.

When two or more pipe structures are laid under the same embankment, the minimum spacing between barrels shall be 3 feet.

The minimum distance between the vertical inlets should be computed by the formula:

$D = 2H + 2$ where D is the minimum distance

between vertical inlet. in feet, and H is the head over

crest or lip in feet where pipe flow occurs.

<u>Antiseep Collars</u>

Minimum antiseep collar projection shall be 2 feet. One antiseep collar shall be used where the embankment fill over the barrel is 20 feet or less. Two antiseep collars shall be used where the fill over the barrel is between 20 and 25 feet. When the height of fill over the barrel exceeds 25 feet, sufficient number of antiseep collars shall be installed to increase the length of seep line of the barrel by 15 percent.

The length of conduit in the saturation zone is normally assumed to equal that portion of conduit within the confines of the embankment. When one anti seep collar is required, it shall be placed at the approximate centerline of the embankment.

A filter diaphram may be used in lieu of antiseep collars. The filter diaphram shall be designed and installed in accordance with Texas NRCS standard drawings.

Emergency Spillways. The design capacity of earth spillways shall be based on the procedures and methods given in Engineering Field Manual for Conservation Practices, Texas Engineering Technical Note No. 210-15-TX1, Erosion Control Practices, or Technical Release No.2 - Earth Spillways, and SCS-TP-61, Handbook of Channel Design for Soil and Water Conservation or based on water surface profiles.

Peak discharge shall be obtained using procedures contained in Texas Engineering Technical Note No. 210-18-TX5, Estimating Runoff For Conservation Practices. Peak discharge may be reduced by flood routing.

If flood routed, TR-48 Structure Analysis (DAMS2) or other method approved by the State Conservation Engineer shall be used on Job Class V or larger and inventory size dams. Either Average Condition Runoff Curve Number (CN) shown on Figure 1 of TETN No. 210-18-TX5 or Antecedent Moisture Condition (AMC) II may be used to determine the runoff curve number. Stream hydraulics (calculation of velocities assuming uniform or gradually varied flow conditions) is the preferred method for calculating $T_{c.}$ *If* T_c *is calculated from a published formula, the associated average velocity shall be checked for reasonableness.*

DESIGN CRITERIA FOR EXCAVATED PONDS

Excavated Material. In addition to other methods of disposal, the excavated material may be placed as follows: When the excavated material and the cut bank form a continuous slope, the front slope of the excavated material and the cut bank shall not be steeper than 2.5 to 1 and the back slope on normal angle of repose for the material. The maximum height of the excavated material not to be more than 8 feet above normal ground and the top made uniform and not left in a "moundy" condition.

Seep type ponds will be designed with the same criteria as the other excavated ponds with the following additional criteria: Location shall be made where the static water level is within 4.0 feet of the average ground elevation. The maximum depth of the pond should not exceed 10.0 feet below the static water level. The minimum depth should be at least 6.0 feet below the static water level. Sufficient number of borings shall be made and elevations recorded to determine the depth to the water-bearing strata, and to determine that the water-bearing strata are deep enough to provide adequate water.

DESIGN CRITERIA FOR NON-COMMERCIAL FISH PONDS

Non-commercial fish Ponds shall meet design criteria for embankment or excavated ponds as well as the following additional criteria.

Surface Area. Fish ponds should have a minimum surface area of 1 acre.

Minimum Depth. If the water surface is held at a constant level by wells, springs, etc., the minimum pond depth should be 4 feet over at least 80 percent of the pond area.

Shoreline. To reduce shallow water, a minimum of 3/4 of the shoreline at normal water level should be constructed with side slopes of 3:1 or steeper to a minimum depth of 3 feet. Normal waterline is usually considered 2 feet below emergency spillway level on ponds without a trickle tube or principal spillway. The natural or undisturbed shoreline should be restricted to the upstream end of the pond surface.

Emergency Spillways. *Emergency spillways or bypass areas shall be as wide as possible to minimize flow depths. A screen shall not be constructed across the emergency spillway.*

Drain Pipe. *Enclosed ponds should be designed with a drain pipe. All other ponds except "excavated" ponds should have a drain pipe. Drain pipe should have sufficient capacity to drain pond in 7-14 days.*

Trickle Tubes. *Embankment ponds with trickle tubes and principal spillway should be constructed to remove water as follows:*

1. *Ponds 6 feet deep or less -water shall be removed from the pond bottom.*

2. *Ponds more than 6 feet deep -water shall be removed from a point at least 6 feet below the water surface.*

Woody Vegetation. *All brush, trees, stumps, and other major debris should be removed below the emergency spillway elevation in ponds which are to be intensively managed and fertilized. For those ponds not intensively managed and properly fertilized, 10 to 50 percent of the pond area below the emergency spillway elevation should be retained in standing woody vegetation. The amount of standing woody vegetation left will depend on the desires of the pond owner and the construction requirements of the pond. Brush piles (shelters) can be constructed in the deepest portion of the pond. These brush piles (shelters) should be firmly anchored to prevent floating debris.*

PLANS AND SPECIFICATIONS

Construction specifications describing the requirements for applying this practice shall be developed from the generalized construction specifications for Conservation Practice. The Construction Details section shall be used to describe site specific job requirements.

GAGES FOR VERTICAL INLETS

TABLE 1
MAXIMUM HEIGHT OF INLET (FT)

STEEL PIPE

	2-2/3 x 1/2" Corrugations					3 x 1 Corrugations
Dia.	16 ga.	14 ga.	12 ga.	10 ga.	8 ga.	16 ga.
24"	25*	25*	25*	25*	25*	25*
30"						
36"						
42"						
48"						
54"						
60"	↓					
66"	21'	↓				
72"	16'	20'	↓			
78"	13'	16'	23'	↓		
84"	10'	13'	18'	24'	↓	↓

*Maximum height limit is 25 ft. for steel.

ALUMINUM PIPE

	14	12	10	8		
	2-2/3 x 1/2" Corrugations				3 x 1 Corrugations	
Dia.	.075'	.105"	.135"	.164"	.075	.105
24"	20*	20*	20*	20*	20*	20*
30"						
36"	↓					
42"	17'	↓				
48"	12'	17'	↓			
54"	8'	12'	15'	↓		
60"	6'	8'	11'	14'	↓	
66"	5'	6'	8'	11'	20'	
72"	4'	5'	6'	8'	16'	↓

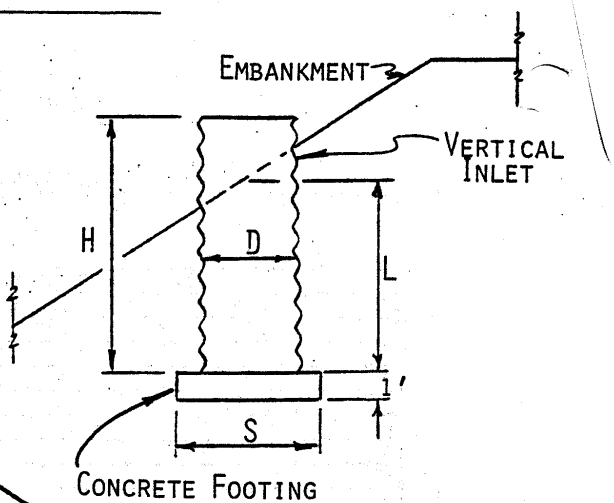
*Maximum height limit is 20 ft. for aluminum.

EXAMPLE: Find required gage or thickness for 66" vertical inlet 15 ft. high:

	STEEL		ALUMINUM	
Dia.	2-2/3 x 1/2	3 x 1	2-2/3 x 1/2	3 x 1
66"	16 ga.	16 ga.	None**	.075"

**Maximum length for 66" diameter .164" thick vertical inlet is 11'

CONCRETE FOOTING DIMENSION



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H	0	2	4	6	8	10	12	14	16	18	20	22	24
2.00	1.0577												
3.00	1.2954												
4.00	1.4958	1.2427											
5.00	1.6724	1.3553											
6.00	1.8320	1.4591	1.3019										
7.00	1.9788	1.5561	1.3758										
8.00	2.1154	1.6474	1.4459	1.3312									
9.00	2.2437	1.7338	1.5128	1.3862									
10.00	2.3651	1.8162	1.5769	1.4391	1.3486								
11.00	2.4805	1.8950	1.6384	1.4902	1.3925								
12.00	2.5908	1.9706	1.6977	1.5396	1.4350	1.3602							
13.00	2.6966	2.0434	1.7551	1.5874	1.4763	1.3967							
14.00	2.7984	2.1138	1.8106	1.6338	1.5165	1.4322	1.3685						
15.00	2.8966	2.1818	1.8644	1.6790	1.5556	1.4669	1.3997						
16.00	2.9916	2.2478	1.9167	1.7229	1.5938	1.5007	1.4302	1.3747					
17.00	3.0837	2.3119	1.9677	1.7658	1.6310	1.5338	1.4601	1.4019					
18.00	3.1731	2.3743	2.0174	1.8077	1.6675	1.5663	1.4893	1.4287	1.3795				
19.00	3.2600	2.4351	2.0658	1.8486	1.7031	1.5980	1.5180	1.4549	1.4037				
20.00	3.3447	2.4944	2.1132	1.8886	1.7381	1.6292	1.5462	1.4807	1.4275	1.3834			
21.00	3.4273	2.5524	2.1595	1.9278	1.7723	1.6597	1.5739	1.5060	1.4509	1.4051			
22.00	3.5080	2.6090	2.2048	1.9662	1.8059	1.6897	1.6011	1.5309	1.4739	1.4265	1.3865		
23.00	3.5868	2.6644	2.2493	2.0039	1.8389	1.7192	1.6278	1.5555	1.4966	1.4477	1.4063		
24.00	3.6640	2.7187	2.2928	2.0409	1.8713	1.7482	1.6541	1.5796	1.5189	1.4685	1.4258	1.3891	
25.00	3.7395	2.7720	2.3356	2.0772	1.9032	1.7767	1.6800	1.6034	1.5409	1.4890	1.4450	1.4072	
26.00	3.8136	2.8242	2.3776	2.1129	1.9345	1.8047	1.7055	1.6268	1.5626	1.5092	1.4640	1.4251	1.3913

S/D FACTORS

TABLE 2

EXAMPLE:

L = 10 FT
H = 15 FT
D = 4.0 FT

FROM TABLE S/D = 1.4669
S = (1.4669)(4.0) = 5.87 FT ≈ 6.0 FT
USE 6' x 6' x 1' CONCRETE BASE

APPROVAL AND CERTIFICATION

POND

(No.)

CODE 378

PRACTICE STANDARD APPROVED:

/s/ JOHN W. MUELLER	**06/12/02**
State Conservation Engineer	**Date**